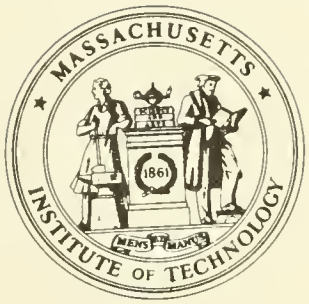
BASEMENT



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MANAGEMENT USE OF COMPUTERIZED MICRO-ANALYTIC BEHAVIORAL SIMULATIONS

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Arnold E. Amstutz

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MANAGEMENT USE OF COMPUTERIZED MICRO-ANALYTIC BEHAVIORAL SIMULATIONS*

by

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Massachusetts Institute of Technology

Abstract

The paper reviews the development, testing, and implementation of large scale computerized micro-analytic simulations of market behavior. Problems associated with model conception and specification, function verification, and system and sub-system testing and validation are discussed with reference to operating systems. Sample simulation runs based on regional test markets are evaluated and representative management uses of the system are discussed.

*A talk presented at The Institute of Management Science meeting in Dallas, Texas, February 17, 1966.

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Since 1959 the author has been working with cooperating managements in the development, validation, and implementation of micro-analytic behavioral simulations designed to aid management in the formulation and evaluation of alternative marketing policies and strategies. This work has focused on a particular class of decision situation in which the simulation approach has shown unusual promise. These situations are characterized by two common elements. First, controlling considerations involve human behavior and second, management must influence actions through persuasion in order to achieve desired results -- management is not able to exercise direct control.

The planning and implementation of marketing programs involve the coordination of many types of management activity designed to persuade the prospective customer to take actions or develop attitudes and beliefs favorable to a particular company's brands. Simulation systems designed for use by marketing management focus on the processes through which management attempts to influence behavior in the market. The models on which such simulations are based encompass micro-analytic representations of retailer, distributor, salesman, and consumer and industrial purchaser behavior and competitive interactions in the environment external to the corporation.

The System Development Procedure

In developing a computerized micro-analytic simulation of market behavior, the firm and its competitors are viewed as input generators. The external market simulation is intended to duplicate response characteristics of a

comparable real world market to inputs of the type generated by the firm and other market sectors.

The process followed in developing a microanalytic simulation having desired response characteristics may be illustrated with reference to the activities of a consumer products manufacturer.

Boundary Definition

System development activity normally begins with a definition of boundaries for the system. In establishing boundary limits management attempts to specify the scope of the system to be developed. In most instances this preliminary specification is relatively crude. Management generally attempts to describe basic macro sectors to be encompassed by the system. This description may be of the form illustrated in Figure 1. This figure defines the extent of management concern in terms of an environment consisting of manufacturers, distributors, retailers, and consumers. The figure also indicates management interest in interactions between these basic sectors.

Objective Formulation

In beginning system development, management must specify the objectives which they hope to achieve through use of the system once it has been developed, validated, and implemented. Objectives are often explicated in terms of criteria of relevancy applied in determining whether a particular aspect of the environment will be included in or excluded from the system. Objective specifications also indicate the level of detail and accuracy which management requires of the operating system.

Description of Macro Behavior

Once desired system scope and objectives to be achieved through system use have been specified model development continues with sequential steps in

the process involving increasingly detailed description of behavior within the environment to be simulated.

Figure 2 illustrates the second step in management progress toward specification of a system. Concepts illustrated in Figure 1 have been expanded through recognition of government and salesmen. The description of interactions between sectors has become more explicit. Information flows are now differentiated from product flow. (In later stages, additional recognition was given to the flow of value or capital within this part of the system.) Management's initial conception of interactions within the market is expressed in terms of bilateral channels relating the manufacturer and his competitors to distributors and retailers through their respective salesmen. Unilateral communication channels permit communication from the manufacturer to the consumer directly, and through trade channels.

Additional detail is added to the description of each interaction taking account of numerous backlogs, delays, and transfer points at which the rate of product, information, or value flow may be measured. Figure 3 illustrates this development for the channel of product flow represented by solid lines in Figure 2.

At the final stage of system specification management and the system analyst formulate a macro description of major decision points within the environment to be simulated. Figure 4 illustrates one such description of decision and response factors within the manufacturing, retailer, and consumer sectors.

Description of Decision Processes

Once key decision and response elements have been identified, the focus of model development shifts from description of relationships to formulation of behavioral theory. Each decision point is described in terms of inputs

to and outputs from that decision. Hypothesized relationships between inputs and observable behavior are formulated in terms of measurements which permit validation of the model against data from the real world. The "decision to shop" noted in the consumer sector of Figure 4 provides an example of a behavioral formulation involving representative data reference problems.

The conceptual framework summarized in Figure 4 hypothesizes an explicit consumer decision to go to a store seeking a particular brand of product or information about that brand. This decision structure was based on evidence suggesting that consumers entering a store with an explicit intention to investigate or acquire a particular brand exhibit behavior significantly different from that of consumers who accidentally encounter a brand or product line in the course of broader shopping (search) activity.

The Perceived Need Concept -- An Example

Evaluation of research focusing on the decision to shop led to a qualitative concept of "perceived need". This concept might be viewed as an extension of utility theory. It was argued that the consumer's motivation to take action to acquire a particular brand is related to his perceived need for that brand which increases with (1) positive attitude toward the brand; (2) opportunity for brand use; and (3) time since purchase.

This qualitative concept was later refined to the series of relationships illustrated in Figures 6, 7, and 8.

The Effect of Attitude

Using a modified Osgood scale consumer orientation (attitude) toward a brand is measured by asking a respondent to rate the brand on an eleven point scale from +5 (strongly favor) through 0 (indifferent) to -5 (strongly dislike). The observed relationship between attitude (measured using the scale shown in Figure 5) and "Perceived Need" is illustrated in Figure 6.

Use Opportunity

Use opportunity is measured in terms of the number of times that the consumer had an opportunity to use a brand within the product class being studied during the preceding quarter. This information is obtained by direct interview as well as diary maintenance.

Time Since Purchase

The time since purchase is measured, as the name suggests, by determining the time (in weeks) since the consumer last purchased a brand in the product class being studied.

Income Stratification

Attempts to validate the perceived need construct produced evidence that the relationship between the three perceived need measures and actual shopping behavior is income dependent. Further investigation revealed that behavior could be differentiated by population sub-segments established on the basis of income levels as illustrated in Figure 9.

Probability of Shopping Function

Combining the three elements of perceived need with income stratification produced a function of the type illustrated in Figure 10 relating the probability of shopping to perceived need and income.

Additional Function Formulation

In a similar manner each decision and response function encompassed by macro specifications is investigated. In some instances initial theoretical constructs are validated. In others empirical evidence suggesting alternative constructs is obtained and the process of formulation is repeated for revised structures.

Explicit Decision Representation

Decision and response functions are formulated and tested as probabilities since data from the real world environment are in the form of frequency distributions. Generation of explicit decision outputs for each cell within a simulated population requires conversion of the probabilistic statement into explicit yes/no decisions. A number drawn randomly from a rectangular distribution of range 0 to 1.0 is compared with the stated probability to determine the occurrence of the probabilistic event.[1]

Behavior of an Artificial Population

Once validated at the function level, decision and response formulations of the type described above are combined in a simulation structure encompassing artificial populations exhibiting actions and responses governed by these formulations.

A Week in the Life of a Simulated Consumer

Figure 11 was obtained by monitoring the "thoughts and actions" of one member of a simulated consumer population during a simulated week in which the population experienced events comparable to those encountered by a comparable real world population during the week beginning February 19, 1962.

Identifying Characteristics

The information provided beginning with the third line of output in Figure 11 identifies characteristic attributes of consumer 109. He is a suburban (SU) resident of New England (NE) between 25 and 35 years of age with an income between $8,000 and $10,000 per year, and has a college education. He presently owns a product of brand 3 manufacture purchased six years earlier.

Consumer 109 presently favors retailers 5, 11, and 3 in that order. He

subscribes to or otherwise has available media of types 1, 4, 9, 10, 11, and 12. Media of types 2, 3, 5, 6, 7, 8, and 13 through 24 are not available to him.

Consumer 109's attitudes are summarized in a matrix beginning on line 6 of Figure 11. This matrix indicates his orientation toward 12 product characteristics, 12 appeals, 4 brands, and 18 retailers. From these figures it may be established that the most important (highest attitude) product characteristic insofar as consumer 109 is concerned is characteristic 8 which he regards very highly (+5). Appeals 11 and 4 are similarly indicated as of primary importance to this artificial consumer. From the retailer attitude portion of this matrix his preference for retailers 11 and 5 (both +5 attitudes) and 3 or 16 (both +3 attitudes) may be established. The final entry in the orientation matrix indicates that consumer 109 is aware of brand 1.[2]

Consumer Memory Content

The Line stating'MEMORY DUMP FOLLOWS. BRANDS LISTED IN DESCENDING ORDER 1 THROUGH 4'introduces the print-out of consumer 109's present simulated memory content. This memory dump is a record of noted communications retained by the consumer relating specific product characteristics and appeals to each of four brands. From this report it can be established, for example, that consumer 109 has retained 14 communication exposures associating product characteristic 8 with brand 1, 13 exposures relating product characteristic 8 with brand 2, and 14 exposures associating appeal 7 with brand 3.

Media Exposure and Response

The entry in the report following the memory dump indicates that the segment of the simulation representing media exposure processes has become

operational. Six media appear (are published or broadcast) during week 117. Consumer 109 is not exposed to medium 3 since that medium is not available to him (see media availability indicator in the characteristic output). Medium 4 also appears in week 117 and since it is available to consumer 109 he may be exposed to relevant ads appearing in it. The output indicates that he is exposed to an advertisement for brand 3 but does not note that communication. On the other hand an advertisement for brand 4 also present in medium 4 during week 117 is noted as indicated by the line reading, ADVERTISEMENT 19, BRAND 4 NOTED. CONTENT FOLLOWS. The output message then indicates that advertisement 19 contains a high prominence $(4)^3$ reference to product characteristic 11 and a medium prominence (2) reference to characteristic 4. Advertisement 19 also contains medium prominence references to appeals 5, 7, and 12.

Consumer 109 does not see medium 7 although it appears in week 117, however, he is exposed to three advertisements in medium 12 which also appears during that week. The advertisement for brand 2 is noted while those for brand 3 and 1 are not. Media 16 and 23 also appear in week 117 but are not seen by consumer 109.

Word-of-Mouth Exposure

Report entries following the media exposure section indicates that consumer 109 is exposed to word-of-mouth comment generated by consumers 93, 104, and 117, but fails to note communication from any of these individuals. Had noting occurred, a message content report comparable to that generated for advertising would have specified the information noted.

Product Experience

Consumer 109 did not have product experience during week 117. Had he made use of the product a report of his response to product use indicating product characteristics or appeals, if any, emphasized by the use experience would have been printed.

Decision to Shop

The next entry in the Figure 11 output indicates that consumer 109 has made an explicit decision to shop; that his highest perceived need is for brand 3; and that his first choice retailer is 5. Simulation models representing in-store experience have been loaded.

In-Store Experience

The first entry within the SHOPPING INITIATED section notes that the consumer is exhibiting behavior associated with the explicit decision to shop option and is seeking brand 3 (there is therefore NO SEARCH activity -- no opportunity for accidental exposure). Simulated retailer 5 is carrying brand 3 therefore consumer 109 finds the brand he is seeking (3).

Retailer 5 has placed point-of-sale display material for brand 3. The consumer is exposed and notes its content emphasizing appeals 3 and 6 and product characteristics 5, 7, 10, and 11 as attributes of brand 3. Retailer 5's simulated salesmen are either not pushing brand 3 or busy with other customers. In any event, consumer 109 is not exposed to selling effort while shopping in retailer outlet 5.

Decision to Purchase

The output statement DECISION TO PURCHASE POSITIVE -- BRAND 03, $38.50, specifies that consumer 109 has made a decision to purchase brand 3 at a price of $38.50. The line following indicates that retailer 5 can make immediate delivery of brand 3.

Response to Purchase

Since consumer 109 has now purchased brand 3 his awareness which was favoring brand 2 is changed to favor brand 3.

Word-of-Mouth Generation

Since consumer 109 is now the proud owner of a brand 3 product, it is not surprising to find him initiating word-of-mouth comment regarding his new purchase. The content of his communication regarding brand 3 emphasizes product characteristics 2 and 8 and appeals 4 and 11 -- the appeals and product characteristics toward which he has the highest perceived brand image as indicated in the previous memory dump.

Forgetting

Consumer 109 did not lose any of his existing memory content during week 117.

The final output line of Figure 11 indicates that consumer 109 has concluded week 117.

Simulated Population Behavior

The behavior of population groups within each simulation sector is described by accumulating simulated individual behavior. Population behavior may be summarized in terms of the proportion of purchases allocated to each brand (brand shares), changes in population attitude distributions towards brands or changes in the perceived brand images held by significant population segments.

One Year in the Lives of Two Simulated Consumers

Once the legitimacy of simulated behavior of the type outlined in Figure 11 has been established through Turing tests,[4] the system may be used to produce behavior over time. Figure 12 illustrates the cumulative market

shares generated by two consumers operating in a simulated food product environment in contrast to the appliance environment in which consumer 109 was resident. The two food product consumers purchased only one brand of product during the first two weeks of simulated activity. However, as the simulated year progressed, they tried other brands and by year end their cumulative brand shares were 37.5, 28.3, 21.1, 5.5, and 5.0 for brands 1-Y, 2-X, 2-0, 1-0, and 1-+ as illustrated at the end of the time plot.

Total Population Behavior

Output of the type illustrated in Figure 12 is used primarily to test system stability. Two simulated consumers are no more representative than two real world consumers. Meaningful tests of system response require examination of the behavior exhibited by major population segments. Figure 13 illustrates the weekly purchases of ten brands of product by 250 members of an artificial population segment during the simulated year, 1961. These simulated market shares may be directly compared against data generated during a comparable period in a real world test market.

System Validation

Once a system has been developed and tested to the point where management is convinced of its viability, validation tests designed to determine the extent to which the simulation is an accurate representation of a real world environment must be undertaken. Validation testing generally proceeds sequentially from function analysis through cell and population validation.

Function Level Validation

The first step in function validation is a sensitivity analysis indicating the relative sensitivity of total system performance to various functions within the system structure. Sensitivity testing establishes priorities for

functional validations since it is most reasonable to expend effort in validating those functions on which system performance appears to be most dependent.

In validating a functional relationship the generally followed procedure is to test the null hypothesis that observed relationships are due to random variation through application of a chi square test. Once the null hypothesis is rejected, usually at the 1% level, the degree of correspondence between real world data and theoretical function form is established using standard curve fitting techniques.

Cell Level Validation

Validation at the cell level is to establish that the behavior of an individual within the simulated population cannot be differentiated from that of a similar member of the real world population. First level testing is of the type suggested by Turing.[5] Later tests are designed to assure that the distribution of relevant parameter values (e.g., frequency of brand purchases and changes in attitude and knowledge) exhibited by the simulated and real world consumers under comparable conditions are statistically indistinguishable.

Population Level Validation

Tests focusing on the simulated population are designed to establish the degree of correspondence between behavior exhibited by members of the simulated population and that exhibited by members of the real world population measured in terms of variables relevant to management.

Reliability Testing

In beginning population testing it is necessary to establish that model performance is relatively insensitive to different random number seeds

used on sequential system runs. As an example, in the simulation used to generate the output illustrated in Figure 13 terminal brand share deviation between runs is less than 1%.

Performance Validation

The acid testof simulation system validity is ability to duplicate historical real world population behavior under comparable input conditions. In conducting such tests, the population is initialized to duplicate the distribution of all relevant parameters as they existed at a specified point in time in the real world environment. In the case of the Figure 13 run, the artificial population had been initialized to correspond to conditions existing at the beginning of 1961.

Inputs to the simulation during performance tests describe conditions existing in the real world during the referenced time period. In the case of the test illustrated in Figure 13 conditions were those existing during 1961. Inputs specified the content and related media allocation for all magazine, TV, direct mail, and point-of-sale promotion generated by competitors operating in the test market area during 1961. In addition, product characteristics and distribution conditions were established to correspond with conditions in the real world during 1961.

Analytical procedures applied in performance testing may be summarized with reference to data plotted in Figure 13. The first test performed following this simulation established that the rank order of brand shares at the end of 1961 in the real and simulated worlds were equivalent. Actual-Simulated data comparisons are presented in Figure 14.

The absolute value of brand shares generated by the simulation and real world population were then examined. As indicated in Figure 15 the total error between actual and simulated brand shares at the end of 1961 was 5.1%.

A final class of performance tests focuses on the extent of correspondence between actual and predicted brand shares throughout the entire time period covered by the simulation. Figure 16 illustrates the procedure used to obtain this measure for the 1961 simulation test data. The maximum error in simulation based prediction for any brand was 5.2% while the average error over this time period was .7%.

Management Uses of Simulation

Given a system of the type described in this paper, management must assess system performance in terms of intended applications. If, in their opinion, performance is sufficient to warrant use of the simulation as a representation of the real world environment, applications of the type outlined below may be appropriate. However, if, in their opinion, the simulation fails to duplicate salient attributes of the real world environment further development leading to a more refined system must be undertaken or the use of the technique rejected.

Testing Implicit Models

One of the first benefits to accrue from the development of a simulation system is the systematic testing of management conceptions of the environment in which they operate. In reviewing alternative formulations and evaluating functions, cell model behavior, and total population performance management must make explicit the often implicit models on which their decision making is based.

The "What If?" Question

Given that management accepts simulation performance as indicative of real world response under comparable conditions, the simulation becomes a test market without a memory in which management may examine with impunity

the implications of alternative policies and strategies. Whether introducing new products or considering modification of a marketing program, management may apply alternative strategies in the simulated environment and evaluate their implications under various assumed competitive conditions.

The effectiveness of such pretesting is dependent on management's ability to predict probable competitive responses to proposed actions as well as the accuracy of the simulation system. Management may find it profitable to examine the impact of best and worst case competitive response patterns. In most instances the best case assumes that competition will continue with programs developed prior to initiation of company actions, while the worst case assumes full competitor knowledge of the proposed company program and combined action to thwart company efforts.

Performance References

The simulated environment provides the references against which the progress of operations in the real world may be measured. Given a simulation pre-test, management can determine by monitoring appropriate variables whether or not a program is progressing as planned. If conditions producing satisfactory performance in the simulated environment are encountered in the real world, it is assumed that final results will be comparable. Differences between simulated and experienced results are viewed as potential bases for failure to achieve real world performance comparable to simulation results.

Summary

This paper has examined procedures followed in developing, testing, and validating computerized micro-analytic behavioral simulations. The process of boundary definition, macro and micro behavior description, and decision function formulation has been discussed with reference to sample system

structures. System performance characteristics and procedures for simulation validation at the function, cell and population level were considered in context of output obtained from operating systems. It has been suggested that simulation systems have the potential to contribute significantly as vehicles for testing pre-conceptions regarding complex environments, evaluating the implication of alternative policies and strategies, and providing performance references against which operational effectiveness may be assessed.

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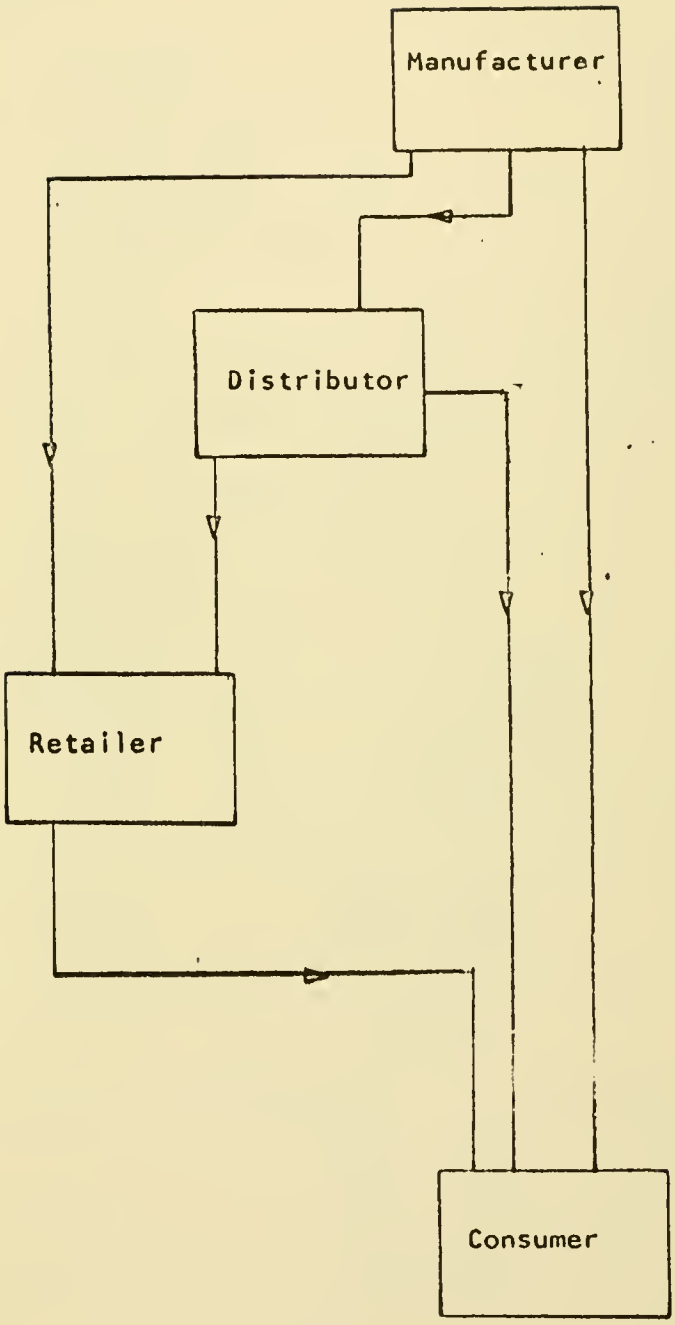


FIGURE 1

PRODUCT FLOW CHANNELS -- A MACRO VIEW

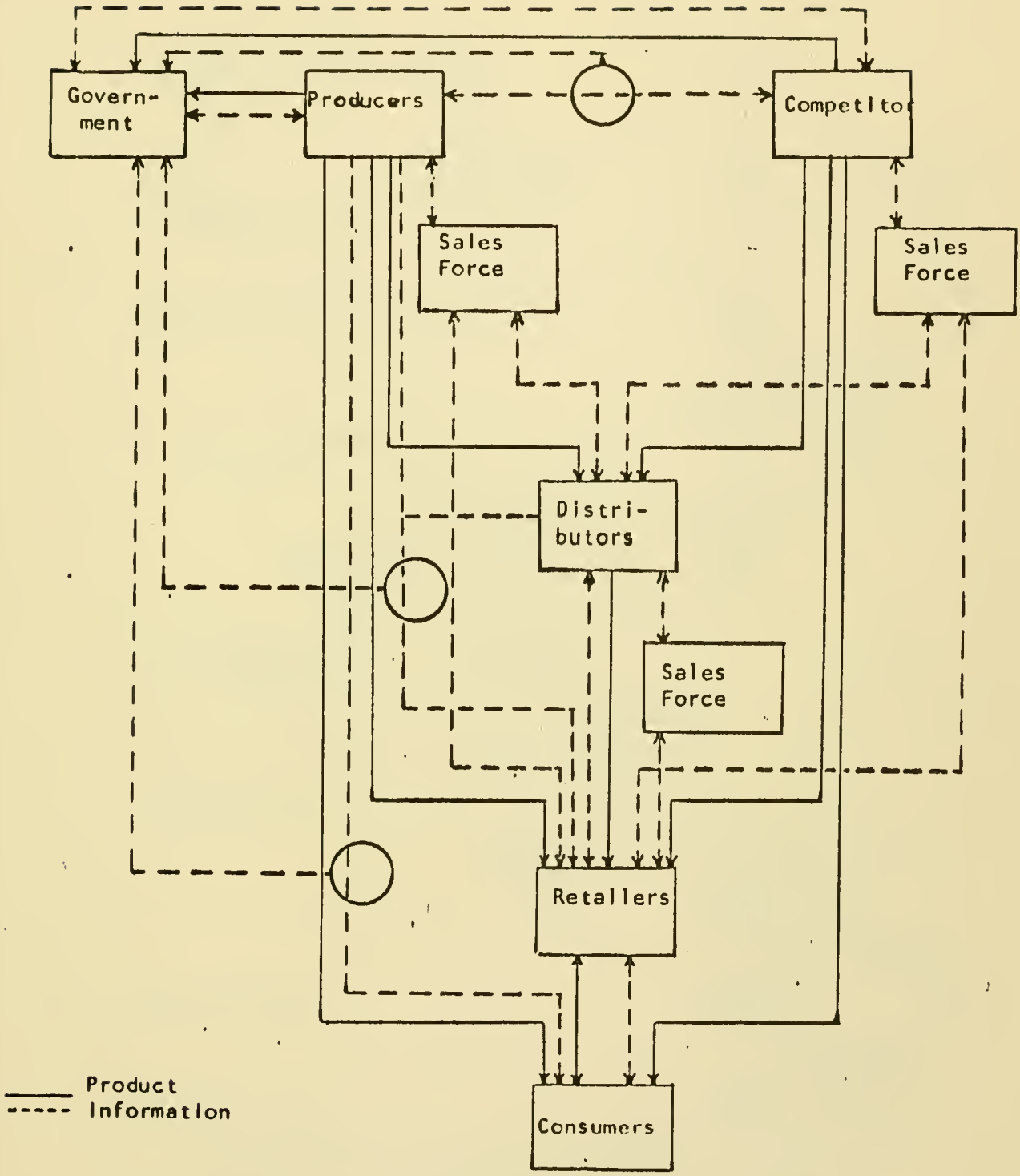


FIGURE 2

MACRO FLOW CHART EXAMPLE

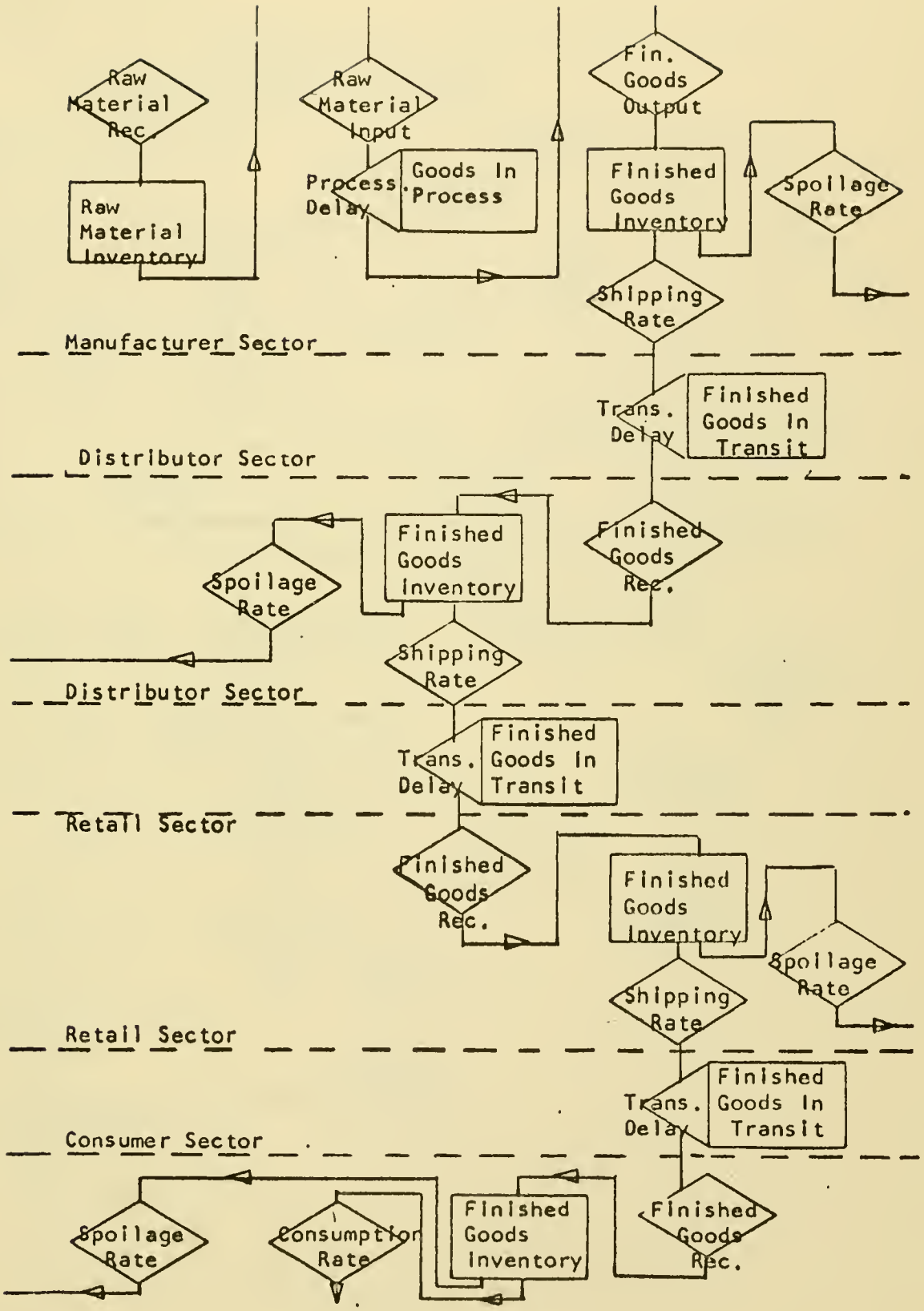


FIGURE 3

SUMMARY OF PRODUCT FLOW BASED PROCESSES

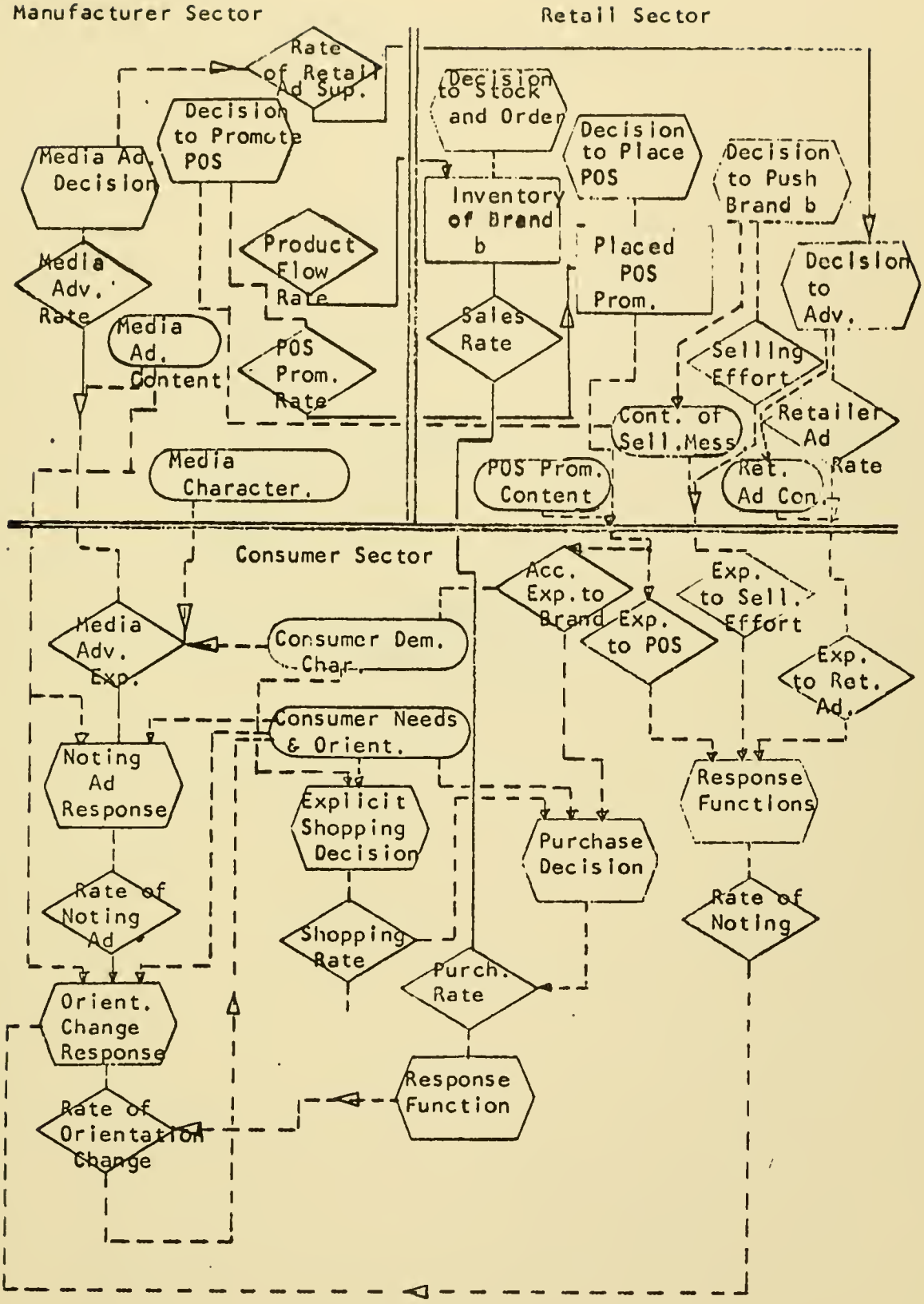


FIGURE 4

MACRO FLOW CHART OF CONSUMER MODEL INTERACTIONS

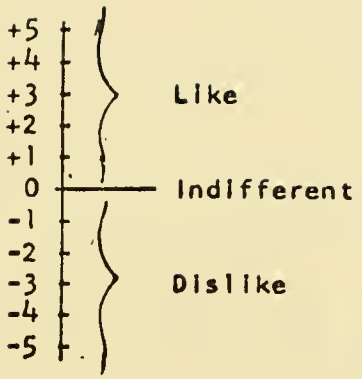


FIGURE 5

THE ATTITUDE SCALE

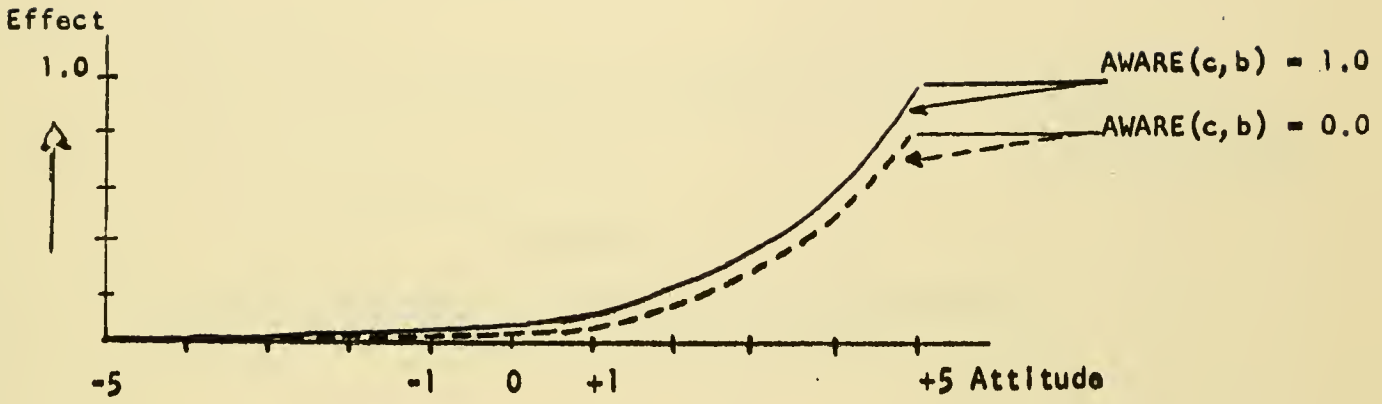


FIGURE 6

EFFECT OF ATTITUDE ON PERCEIVED NEED

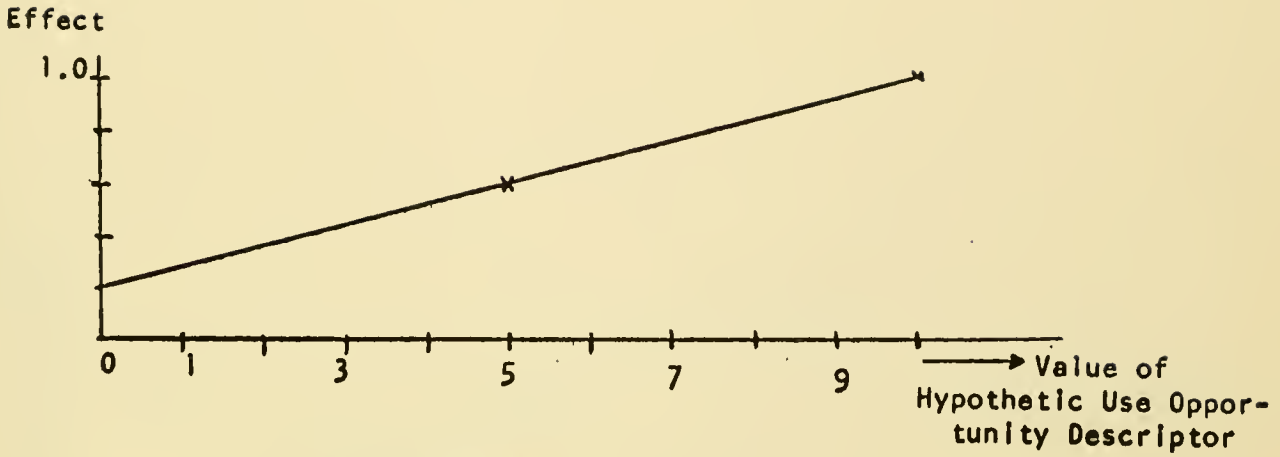


FIGURE 7

EFFECT OF CONSUMER USE OPPORTUNITY ON PERCEIVED NEED

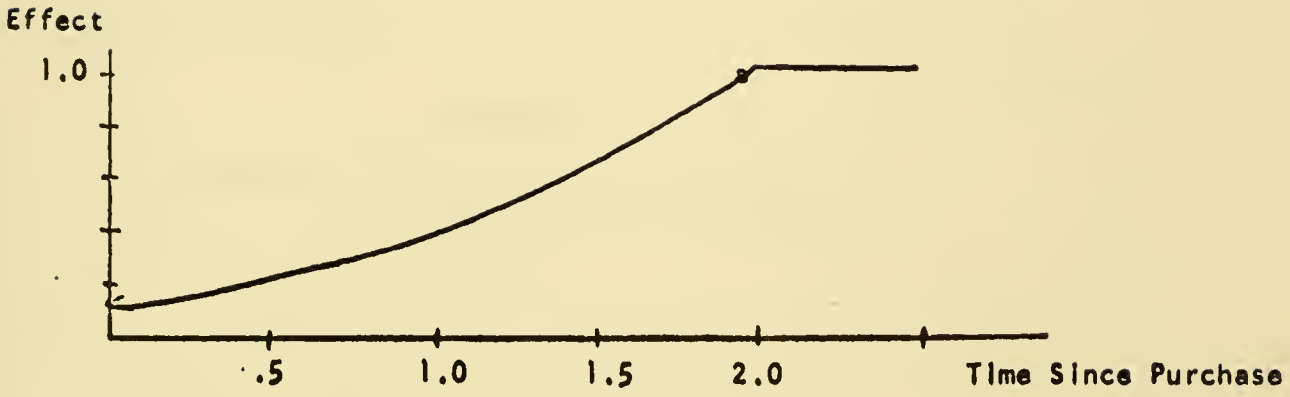


FIGURE 8

EFFECT OF TIME SINCE PURCHASE ON PERCEIVED NEED

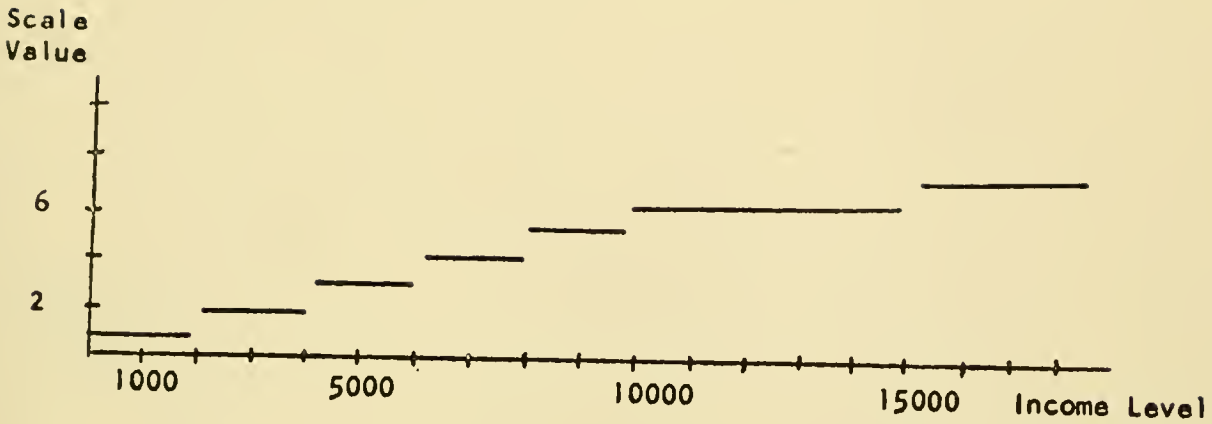


FIGURE 9

INCOME SCALE FOR SAMPLE PRODUCT FORMULATION

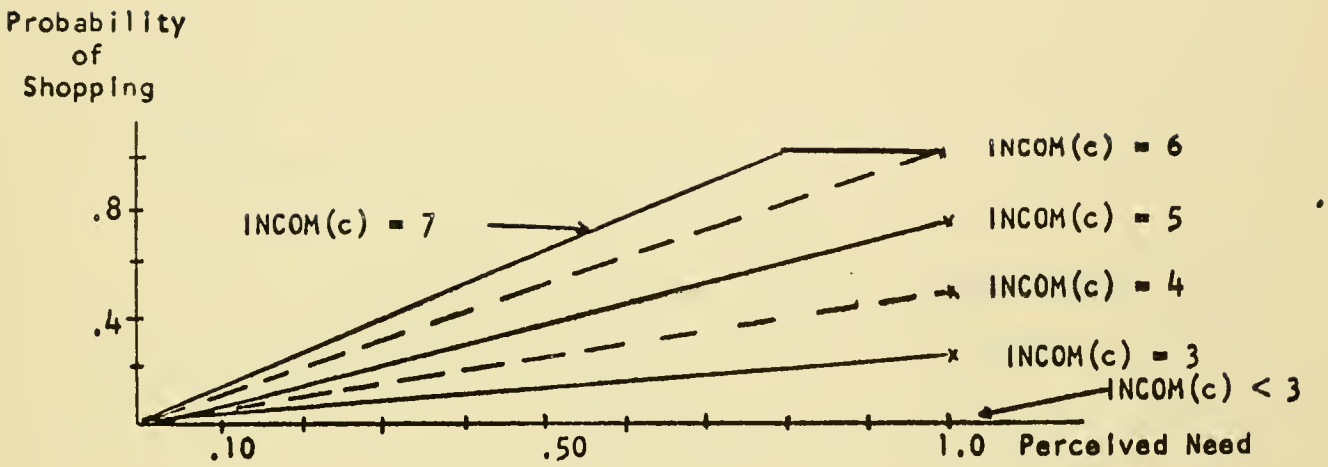


FIGURE 10

PROBABILITY OF SHOPPING AS FUNCTION OF

PERCEIVED NEED AND INCOME

SIMULATION APP-03 TEST RUN APRIL 4, 1965 1400 HOURS

-- CONSUMER 0109 NOW BEGINNING WEEK 117 -- FEBRUARY 19, 1962

- REPORT MONITOR SPECIFIED. TO CANCEL PUSH INTERRUPT.
- CHARAC - REGION NE SU, AGE 25-35, INCOME 8-10K, EDUCATION COLLEG
- BRANDS OWN 3, 6 YEARS OLD. RETAILER PREFERENCE 05, 11, 03
- MEDIA AVAILABLE 1 0 0 1 0 0 0 0 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0

- ATTITUDES	1	2	3	4	5	6	7	8	9	10	11	12
PROJ CHAR	0	+1	+1	0	-3	-1	0	+5	0	+3	0	0
APPEALS	-3	0	+1	+5	0	-3	+3	0	0	0	+5	0
BRANDS	+2	+1	+3	+2								
RETAILERS	+1	-5	+3	+1	+5	-5	-5	+1	-1	-3	+5	+1
	-3	+1	-1	+3	+1	+1						
AWARENESS	1	0	0	0								

- MEMORY DUMP FOLLOWS. BRANDS LISTED IN DESCENDING ORDER 1 TO 4

PRODUCT CHARACTERISTIC MEMORY												APPEALS MEMORY											
1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
2	3	15	0	5	5	4	14	8	7	1	3	8	9	7	3	1	11	7	4	4	3	9	3
8	0	6	4	9	5	4	13	0	3	6	7	6	8	0	7	0	9	2	4	3	10	3	1
0	6	15	7	0	3	11	3	5	2	5	7	0	4	8	10	9	2	14	3	9	7	9	5
7	9	3	7	3	2	7	2	6	12	14	2	0	9	7	8	13	9	11	6	0	2	5	9

- MEDIA EXPOSURE INITIATED
    - MEDIUM 003 APPEARS IN WEEK 117 -- NO EXPOSURES
    - MEDIUM 004 APPEARS IN WEEK 117
        - EXPOSURE TO AD 013, BRAND 3 -- NO NOTING
        - EXPOSURE TO AD 019, BRAND 4
            - AD 019, BRAND 4 NOTED. CONTENT FOLLOWS
            - PROD. C 11 P=4, 4 P=2,
            - APPEALS 5 P=2, 7 P=2, 12 P=2,
    - MEDIUM 007 APPEARS IN WEEK 117 -- NO EXPOSURES
    - MEDIUM 012 APPEARS IN WEEK 117
        - EXPOSURE TO AD 007, BRAND 2
            - AD 007, BRAND 2 NOTED. CONTENT FOLLOWS
            - PROD. C 8 P=3, 12 P=1,
            - APPEALS 2 P=1, 4 P=1, 6 P=1, 10 P=1,
        - EXPOSURE TO AD 013, BRAND 3 -- NO NOTING
        - EXPOSURE TO AD 004, BRAND 1 -- NO NOTING
    - MEDIUM 016 APPEARS IN WEEK 117 -- NO EXPOSURES
    - MEDIUM 023 APPEARS IN WEEK 117 -- NO EXPOSURES

FIGURE 11

COMPUTER OUTPUT

- WORD OF MOUTH EXPOSURE INITIATED

    - EXPOSURE TO CONSUMER 0093 -- NO NOTING
    - EXPOSURE TO CONSUMER 0104 -- NO NOTING
    - EXPOSURE TO CONSUMER 0117 -- NO NOTING

- NO PRODUCT USE IN WEEK 117

- DECISION TO SHOP POSITIVE -- BRAND 3 HIGH PERCEIVED NEED
    -- RETAILER 05 CHOSEN

- SHOPPING INITIATED

    - CONSUMER DECISION EXPLICIT FOR BRAND 3 -- NO SEARCH
    - PRODUCT EXPOSURE FOR BRAND 3
        - EXPOSURE TO POINT OF SALE 008 FOR BRAND 3
            - POS 008, BRAND 3 NOTED. CONTENT FOLLOWS
            - PROD. C 3 P=4, 6 P=4,
            - APPEALS 5 P=2, 7 P=2, 10 P=2, 11 P=2,
    - NO SELLING EFFORT EXPOSURE IN RETAILER 05

- DECISION TO PURCHASE POSITIVE -- BRAND 3, $ 38.50

    - DELIVERY IMEDAT
    - OWNERSHIP = 3, AWARENESS WAS 2, NOW 3

- WORD OF MOUTH GENERATION INITIATED

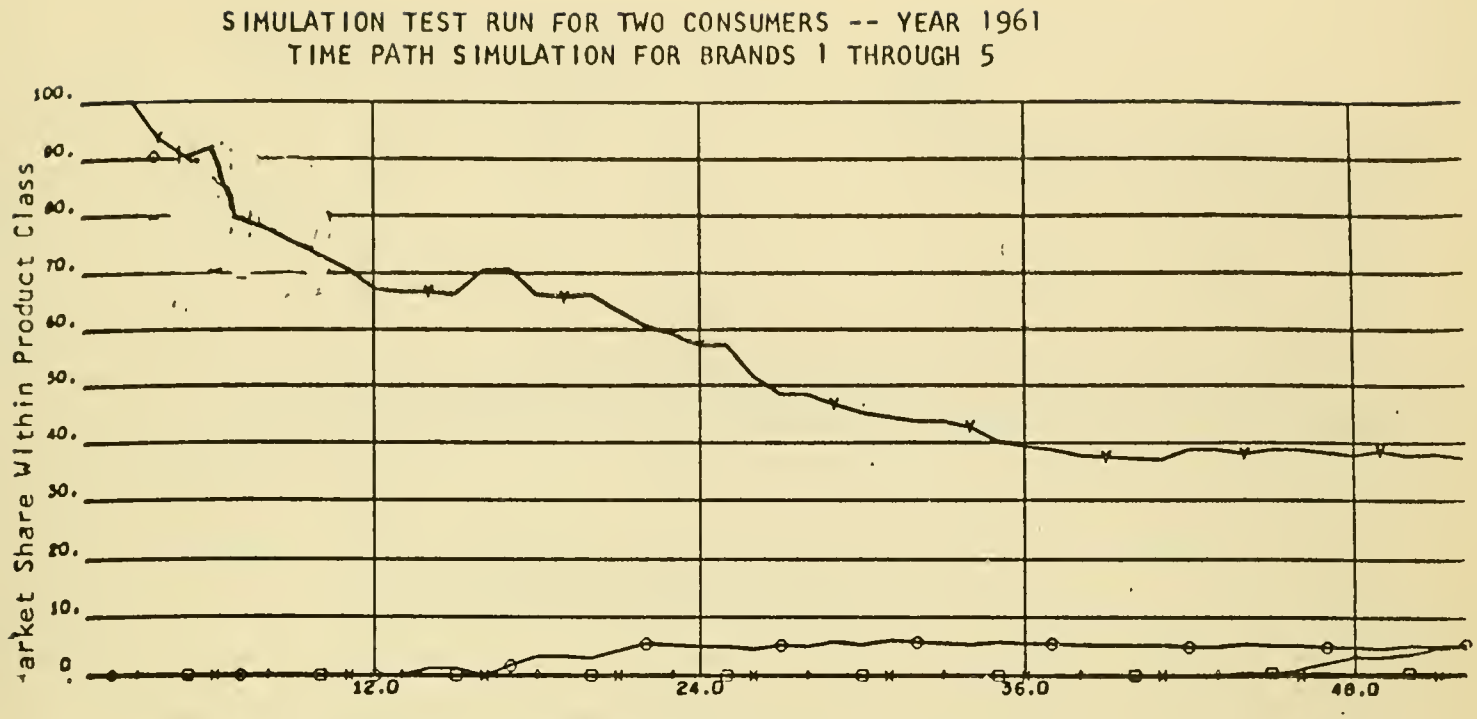
    - CONTENT GENERATED, BRAND 3
        - PROD. C 3 P= +15, 8 P=+15,
        - APPEALS 4 P= +50, 11 P=+45

- FORGETTING INITIATED -- NO FORGETTING D

- CONSUMER 0109 NOW CONCLUDING WEEK 117 -- FEBRUARY 25, 1962

- CONSUMER 0110 NOW BEGINNING WEEK 117 -- FEBRUARY 19, 1962

QUIT,
11.633+4.750



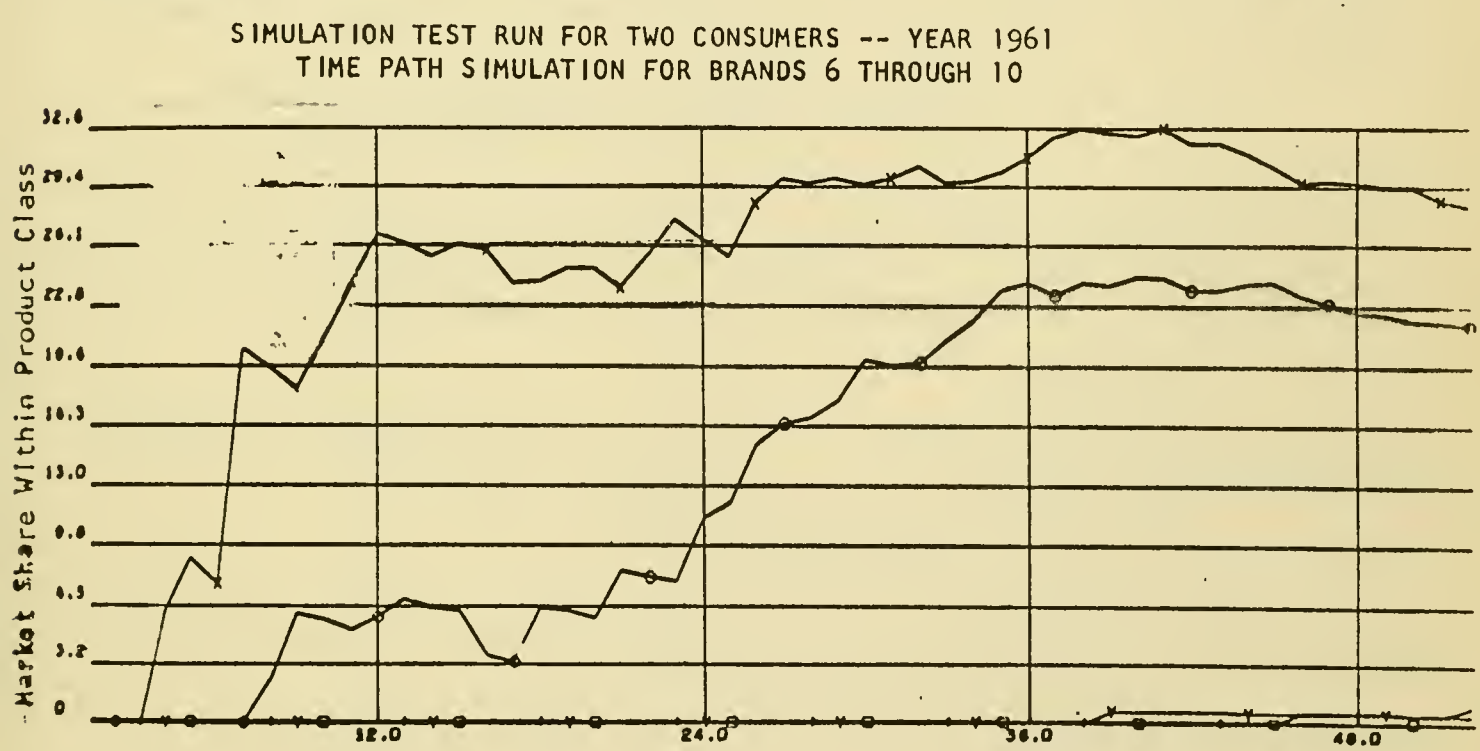
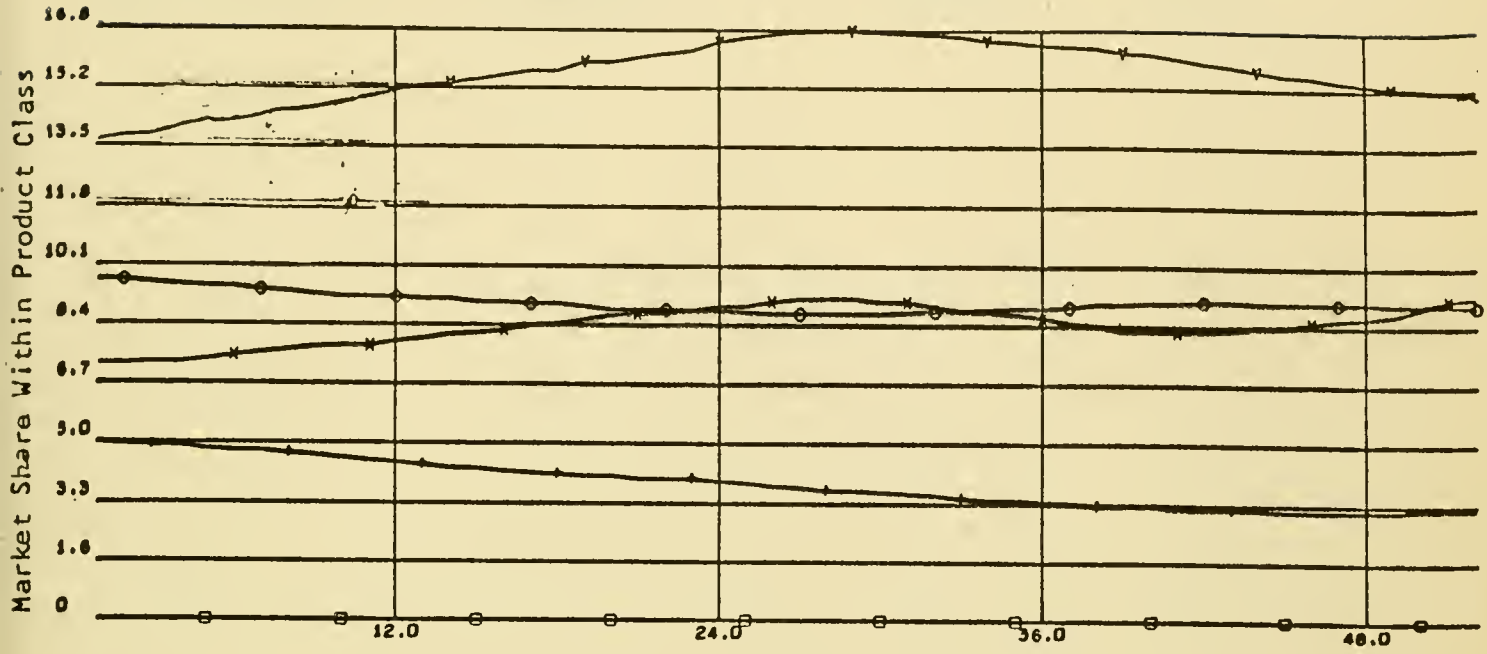


FIGURE 12

TWO CONSUMERS' BRAND SHARE

SIMULATION TEST RUN FOR 250 CONSUMERS -- YEAR 1961
TIME PATH SIMULATION FOR BRANDS 1 THROUGH 5



SIMULATION TEST RUN FOR 250 CONSUMERS -- YEAR 1961
TIME PATH SIMULATION FOR BRANDS 6 THROUGH 10

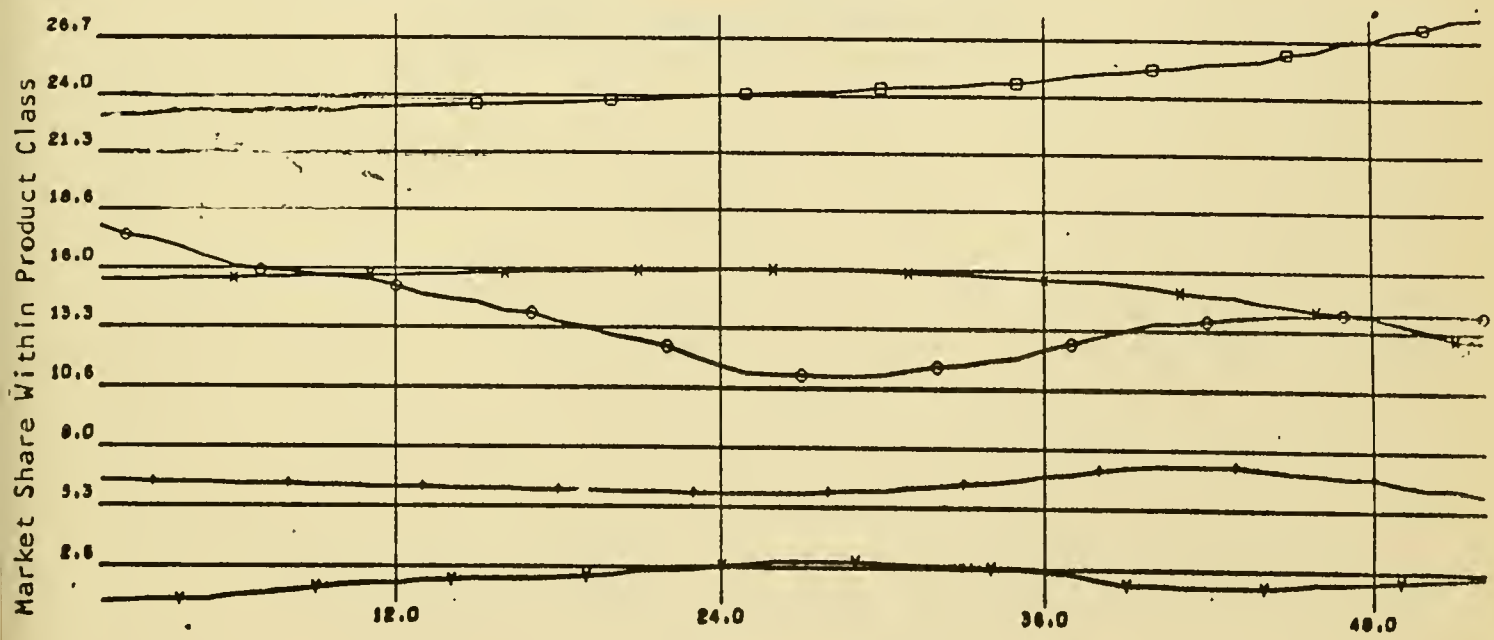


FIGURE 13

250 CONSUMERS' BRAND SHARE

Identification	Rank as Initialized	Year End Rank Simulated	Actual
1 - Y	4	2	2
1 - 0	5	6	6
1 - X	6	5	5
1 - +	8	8	8
1 - □	10	10	10
2 - □	1	1	1
2 - 0	2	3	3
2 - X	3	4	4
2 - +	7	7	7
2 - Y	9	9	9

FIGURE 14

RANK ORDER BRAND SHARE COMPARISONS

Identification	Initialization Value	Year End Value Simulated	Actual	Difference (Magnitude)
1 - Y	13.7%	15.0%	16.1%	-1.1%
1 - 0	9.7	9.1	8.7	+ .4
1 - X	7.3	9.3	9.0	+ .3
1 - +	5.0	3.2	2.8	+ .4
1 -	0	0	0	-
2 -	23.2	27.6	28.8	-1.2
2 - 0	18.1	13.0	12.7	+ .3
2 - X	15.6	13.9	14.4	- .5
2 - +	6.2	5.9	5.5	+ .4
2 - Y	1.0	2.5	2.0	+ .5
Σ	99.8%	99.5%	100.0%	5.1%

FIGURE 15

ABSOLUTE BRAND SHARE COMPARISON

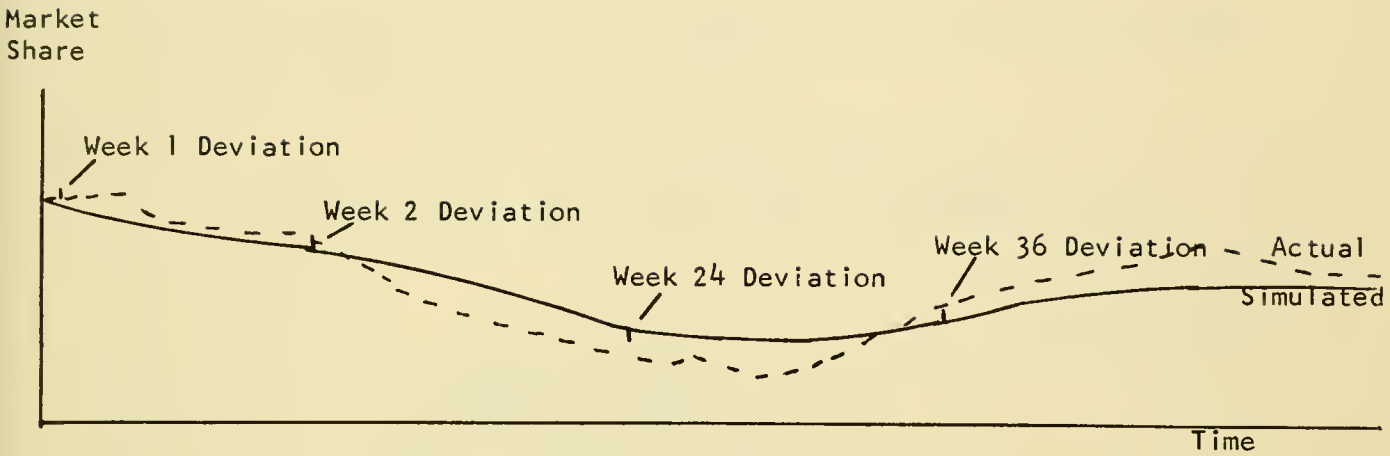


FIGURE 16

OVER-TIME BRAND SHARE DEVIATION -- MEASUREMENT ILLUSTRATION

Total Deviation Over Time for Brand 'b' =

$$\sum_{t=1}^{52} \left| \text{Actual}(b,t) - \text{Simulated}(b,t) \right|$$

Average Error for Ten Brands =

$$\frac{\sum_{b=1}^{10} \text{Total Deviation}}{520}$$

FOOTNOTES

[1] If the number drawn is less than or equal to the stated probability, a positive outcome is assumed.

[2] The awareness measure used in this system is indicative of the respondents top-of-mind cognizance determined by eliciting the name of the first brand in a product class which "comes to mind".

[3] A five point (0-4) prominence scale is used to code content of all communication inputted to the model. Each communication is evaluated using the following coding structure.

Level of Prominence	Evaluation Scale
Extremely Prominent -- Impossible to Miss	4
Very Prominent -- Major Emphasis Given	3
Average Prominence -- Normal Identification	2
Present but not Prominent -- Easily Missed	1
Not Present -- Impossible to Determine	0

[4] Turing has suggested that if a person knowledgeable in the area of simulated decision making cannot distinguish the modeled behavior from reality the model is realistic. See: A. M. Turing, "Computing Machinery and Intelligence", MIND, October 1950, pp. 433-60.

[5] Ibid.

MAR 27 '57

Date Due

AUG 19 '82

[redacted]

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